

CLAIMS

1. (currently amended) A method, comprising:
receiving one or more demands for service in a mesh network comprising a plurality of nodes interconnected by a plurality of links;
specifying a threshold corresponding to a number of failure-related cross-connections; and
mapping each of the one or more demands onto a primary path and a restoration path in the network to generate a path plan for the one or more demands in the network, wherein:
reduction of a portion of restoration time associated with failure-related cross-connections in the network is taken into account during the mapping; and
the mapping generates the path plan based on the specified threshold such that, for all nodes in the mesh network, the number of failure-related cross-connections at each node is less than the specified threshold.

2. (canceled)

3. (currently amended) The ~~invention~~ method of claim 1, wherein the mapping results in a maximum number of failure-related cross-connections at all nodes in the network being within a specified tolerance of a theoretical minimum.

4. (currently amended) The ~~invention~~ method of claim 3, wherein a graph-theoretic condition is used to derive the theoretical minimum.

5. (currently amended) The ~~invention~~ method of claim 4, wherein the theoretical minimum is defined by $\max_{n \in N} \left\{ \lceil \delta_n / d_n \rceil \right\}$ where n , a node in the network, is an element of N , the set of all nodes in the network, δ_n is the number of unit demands terminated on node n , and d_n is the number of edges incident on node n .

6. (currently amended) The ~~invention~~ method of claim 1, wherein the mapping sequentially evaluates each possible path plan for each of the one or more demands and selects the path plan having a smallest maximum number of failure-related cross-connections.

1 7. (currently amended) The invention method of claim 1, wherein the mapping comprises:
2 selecting two node-disjoint paths for each demand, wherein leveling of link loads is taken into
3 account during the selecting; and
4 for each demand, identifying one of the two node-disjoint paths as the primary path and the other
5 as the restoration path, wherein a maximum number of failure-related cross-connections at all nodes in the
6 network is taken into account during the identifying.

1 8. (currently amended) The invention method of claim 7, wherein:
2 selecting the two node-disjoint paths for each demand minimizes maximum link bandwidth in the
3 network; and
4 identifying the primary and restoration paths for each demand results in the maximum number of
5 failure-related cross-connections at all nodes in the network being within a specified tolerance of a
6 theoretical minimum.

1 9. (currently amended) The invention method of claim 8, wherein a tent pole condition is used
2 to derive the theoretical minimum.

1 10. (currently amended) The invention method of claim 7, wherein the selecting of the two
2 node-disjoint paths for each demand and the identifying, for each demand, of the one of the two
3 node-disjoint paths as the primary path and the other as the restoration path are implemented using
4 mixed-integer programming is used in each of the selecting and the identifying.

1 11. (currently amended) The invention method of claim 7, wherein the selecting of the two
2 node-disjoint paths for each demand and the identifying, for each demand, of the one of the two
3 node-disjoint paths as the primary path and the other as the restoration path are implemented using genetic
4 programming is used in each of the selecting and the identifying.

1 12. (currently amended) The invention method of claim 7, wherein the selecting of the two
2 node-disjoint paths for each demand and the identifying, for each demand, of the one of the two
3 node-disjoint paths as the primary path and the other as the restoration path are implemented using a
4 commercial solver is used in each of the selecting and the identifying.

1 13. (currently amended) The ~~invention~~ method of claim 1, wherein the mapping involves
2 demand bundling, wherein demands having a common source node and a common destination node are
3 grouped and routed along a single pair of disjoint primary and restoration paths and at least a portion of
4 connection signaling for the group is carried out jointly.

1 14. (currently amended) The ~~invention~~ method of claim 1, wherein the mapping involves traffic
2 aggregation, wherein multiple low-rate channels in the network are consolidated into a high-rate channel and
3 rerouting of the high-rate channel requires fewer cross-connections than rerouting of the multiple low-rate
4 channels.

1 15. (currently amended) A network manager for a mesh network comprising a plurality of
2 nodes interconnected by a plurality of links, the network manager ~~adapted to~~ comprising:
3 means for receiving ~~receive~~ one or more demands for service in the network;
4 means for specifying a threshold corresponding to a number of failure-related cross-connections;
5 and
6 means for mapping each of the one or more demands onto a primary path and a restoration path in
7 the network to generate a path plan for the one or more demands in the network, wherein:
8 reduction of a portion of restoration time associated with failure-related cross-connections
9 in the network is taken into account during the mapping; and
10 the means for mapping generates the path plan based on the specified threshold such that,
11 for all nodes in the mesh network, the number of failure-related cross-connections at each node is less than
12 the specified threshold.

1 16. (canceled)

1 17. (currently amended) The ~~invention~~ network manager of claim 15, wherein the path plan
2 results in a maximum number of failure-related cross-connections at all nodes in the network being within
3 a specified tolerance of a theoretical minimum.

1 18. (currently amended) The ~~invention~~ network manager of claim 17, wherein a graph-theoretic
2 condition is used to derive the theoretical minimum.

1 19. (currently amended) The invention network manager of claim 18, wherein the theoretical
2 minimum is defined by: $\max_{n \in N} \{ \lceil \delta_n / d_n \rceil \}$ where n , a node in the network, is an element of N , the set
3 of all nodes in the network, δ_n is the number of unit demands terminated on node n , and d_n is the number
4 of edges incident on node n .

1 20. (currently amended) The invention network manager of claim 15, wherein the network
2 manager comprises means for sequentially ~~evaluates~~ evaluating each possible path plan for each of the one
3 or more demands and ~~selects~~ means for selecting the path plan having a smallest maximum number of
4 failure-related cross-connections.

1 21. (currently amended) The invention network manager of claim 15, wherein the network
2 manager ~~is adapted to~~ comprises:
3 means for performing selection of two node-disjoint paths for each demand, wherein leveling of link
4 loads is taken into account during the selection; and
5 means for identifying, for each demand, one of the two node-disjoint paths as the primary path and
6 the other as the restoration path, wherein a maximum number of failure-related cross-connections at all
7 nodes in the network is taken into account during the identifying.

1 22. (currently amended) The invention network manager of claim 21, wherein:
2 the means for performing the selection of the two node-disjoint paths for each demand minimizes
3 maximum link bandwidth in the network; and
4 the means for identifying the primary and restoration paths for each demand results in the maximum
5 number of failure-related cross-connections at all nodes in the network being within a specified tolerance of
6 a theoretical minimum.

1 23. (currently amended) The invention network manager of claim 22, wherein a
2 ~~graph-theoretical result~~ tent pole condition is used to derive the theoretical minimum.

1 24. (currently amended) The invention network manager of claim ~~[[22]]~~ 21, wherein the means
2 for performing the selection and the means for identifying the primary and restoration paths are implemented
3 using mixed-integer programming is used in each of the selection and the identifying.

1 25. (currently amended) The ~~invention~~ network manager of claim ~~[[22]]~~ 21, wherein the means
2 for performing the selection and the means for identifying the primary and restoration paths are implemented
3 using genetic programming is used in each of the selection and the identifying.

1 26. (currently amended) The ~~invention~~ network manager of claim ~~[[22]]~~ 21, wherein the means
2 for performing the selection and the means for identifying the primary and restoration paths are implemented
3 using a commercial solver is used in each of the selection and the identifying.

1 27. (currently amended) The ~~invention~~ network manager of claim 15, wherein the network
2 manager ~~is adapted to~~ comprises means for considering demand bundling in the generation of the path plan,
3 wherein demands having a common source node and a common destination node are grouped and routed
4 along a single pair of disjoint primary and restoration paths and at least a portion of connection signaling for
5 the group is carried out jointly.

1 28. (currently amended) The ~~invention~~ network manager of claim 15, wherein the network
2 manager ~~is adapted to~~ comprises means for considering traffic aggregation in the generation of the path plan,
3 wherein multiple low-rate channels in the network are consolidated into a high-rate channel and rerouting
4 of the high-rate channel requires fewer cross-connections that rerouting of the multiple low-rate channels.

1 29. (new) A method, comprising:
2 receiving one or more demands for service in a mesh network comprising a plurality of nodes
3 interconnected by a plurality of links; and
4 mapping each of the one or more demands onto a primary path and a restoration path in the network
5 to generate a path plan for the one or more demands in the network, wherein:
6 reduction of a portion of restoration time associated with failure-related cross-connections
7 in the network is taken into account during the mapping;
8 the mapping results in a maximum number of failure-related cross-connections at all nodes
9 in the network being within a specified tolerance of a theoretical minimum;
10 a graph-theoretic condition is used to derive the theoretical minimum; and
11 the theoretical minimum is defined by $\max_{n \in N} \{ \lceil \delta_n / d_n \rceil \}$ where n , a node in the
12 network, is an element of N , the set of all nodes in the network, δ_n is the number of unit demands
13 terminated on node n , and d_n is the number of edges incident on node n .

1 30. (new) A network manager for a mesh network comprising a plurality of nodes
2 interconnected by a plurality of links, the network manager comprising:
3 means for receiving one or more demands for service in the network; and
4 means for mapping each of the one or more demands onto a primary path and a restoration path in
5 the network to generate a path plan for the one or more demands in the network, wherein:
6 reduction of a portion of restoration time associated with failure-related cross-connections
7 in the network is taken into account during the mapping;
8 the path plan results in a maximum number of failure-related cross-connections at all nodes
9 in the network being within a specified tolerance of a theoretical minimum;
10 a graph-theoretic condition is used to derive the theoretical minimum; and
11 the theoretical minimum is defined by: $\max_{n \in N} \left\{ \lceil \delta_n / d_n \rceil \right\}$ where n , a node in the
12 network, is an element of N , the set of all nodes in the network, δ_n is the number of unit demands
13 terminated on node n , and d_n is the number of edges incident on node n .